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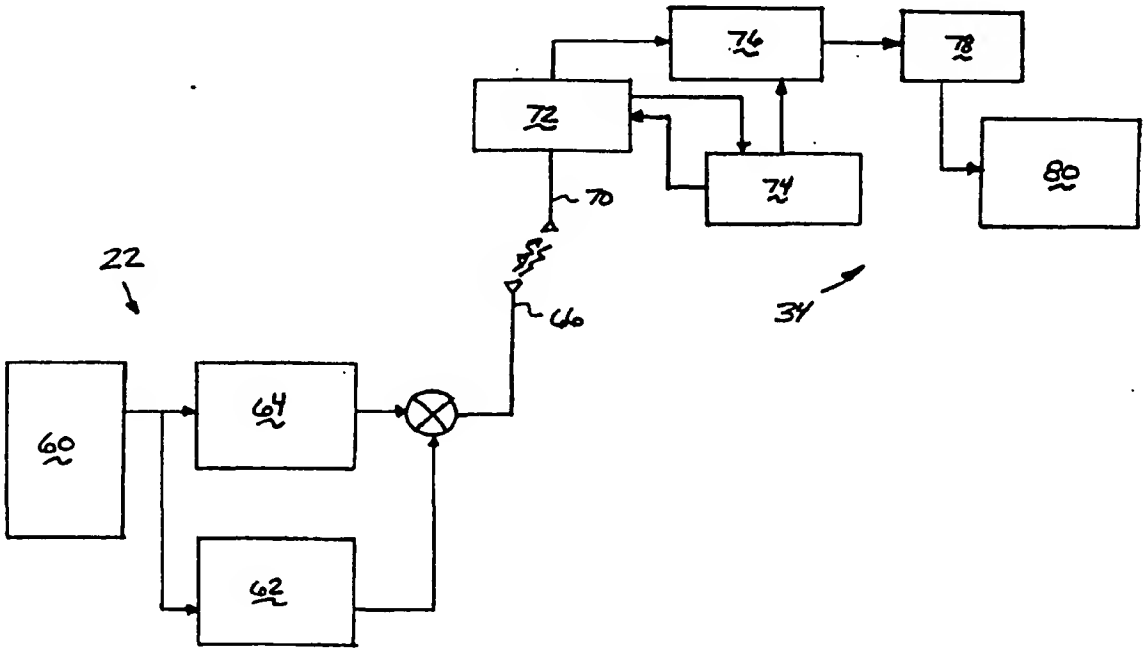

(57) Abstract

A remote keyless entry system includes a remote signal transmitter (22) that transmits signal (40) information at a plurality of frequencies (42–50). A receiver (34) includes a detector portion (74) that detects an amount of noise at each of the frequencies utilized by the remote transmitter. A selector portion (72) selects the frequency having the least amount of noise. A receiver portion (76) receives the remotely transmitted signal at the selected frequency. The received signal is processed to effect the desired operation of the system. The signal can be simultaneously transmitted at each of the frequencies.

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MULTIPLE CHANNEL REMOTE KEYLESS ENTRY SYSTEM

TECHNICAL FIELD

This invention generally relates to remote keyless entry systems and, more particularly, to remote keyless entry systems utilizing multiple frequencies for transmitting signals.

BACKGROUND OF THE INVENTION

A variety of vehicle security systems are commercially available. Remote keyless entry features are included with many of those systems. Additionally, remote keyless entry systems are available as options on many vehicles. With the increased popularity of remote keyless entry systems, a variety of problems and design challenges have arisen.

One such problem is to design a system that operates at a low enough power so that components can be used for the system that keep the costs of the system low. The low power systems typically have a relatively limited frequency range. With the increasing popularity of such systems, the frequency range available for low power systems has become crowded which can lead to difficulty in having effective communication between a remote transmitting device and the controller operating the keyless entry system.

Additionally, even when low power systems are not used, the large number of wireless and radio frequency communication systems can still cause noise or interference in such systems. Thus, there is a need for a wireless control system that is immune from stopband noise jamming (caused by narrow band noise) and passband noise jamming.

This invention provides a system and method that overcomes the shortcomings and drawbacks associated with prior systems while solving the problems discussed above.

SUMMARY OF THE INVENTION

In general terms, this invention is a system for controlling a security device, such as a remote keyless entry system, that transmits a signal over a plurality of frequencies. A remote signal transmitter transmits a signal containing information that will be processed by a signal processor portion of a receiver. The information within the transmitted signal causes a desired operation of the security system. In a preferred embodiment, the transmitter transmits the signal information at a plurality of frequencies. The receiver includes a detector portion that detects an amount of noise at each of a plurality of frequencies. A selector portion selects the frequency with the least amount of noise. The selected frequency is the frequency of the transmitted signal used by the receiver.

Therefore, in accordance with one aspect of the present invention, a wireless system is provided for controlling operation of a security device having a remote signal transmitter arranged to transmit a signal containing control information at a plurality of frequencies, and a receiver comprising a detector portion arranged to detect an amount of noise at each of the plurality of frequencies, a selector portion responsive to the detector portion for selecting the frequency experiencing the least amount of noise, and a signal processor arranged to process the signal received by the receiver at the selected frequency. The processor is further arranged to cause operation of the security device based on the processed signal.

In accordance with another aspect of the present invention, a method is provided for wirelessly controlling a security system that includes selecting a plurality of frequencies, detecting an amount of noise at each of the selected frequencies, and determining which of the frequencies has a smallest amount of noise. A receiving frequency is defined as the frequency with the smallest amount of noise. A signal is transmitted at each of the selected frequencies, and received at the receiving frequency.

The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows.

BRIEF DESCRIPTION OF DRAWINGS

FIGURE 1 is a diagrammatic illustration of a system designed according to this invention.

FIGURE 2 is a schematic illustration of a signal transmission designed according to this invention.

FIGURE 3 is a schematic illustration of a system designed according to this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 illustrates a security system 20. In this example, the security system 20 is a remote keyless entry system. A remote signal transmitter 22 preferably is supported on a key fob 24 in a conventional manner. The key fob preferably is similar to well-known key fobs utilized with one or more conventional keys 26, such as used to operate the ignition of a vehicle. The illustrated key fob 24 includes two switches 28 and 30. The switch 28 preferably is used to signal a desire to unlock the keyless entry system while the switch 30 preferably is utilized to generate a signal indicating a desire to lock the keyless entry system.

The signal from the remote transmitter 22 is communicated to a receiver 34 of the remote keyless entry system on the vehicle 36. The communication between the remote transmitter 22 and the remote keyless entry system receiver 34 is wireless and preferably utilizes radio frequency communication signals.

Figure 2 schematically illustrates a signal 40 generated by the remote signal transmitter 22. The signal 40 includes information indicating the desire of the user of the system. For example, if switch 28 were activated, that indicates a desire to unlock the keyless entry system on the vehicle 36. Accordingly, the signal 40 includes information that would be interpreted by the keyless entry system to effect the desired operation of the system locks. The same information is transmitted by the transmitter 22 at a plurality of frequencies. In the illustration of Figure 2, the signal 40 includes five different frequencies 42, 44, 46, 48 and 50, respectively. Each of these frequencies includes the same information indicating the desired operation of the system. Each of the frequencies, however, are distinct from the others. While five frequencies are illustrated in Figure 2, it is within the scope of this invention to utilize two frequencies or any number greater than two.

Although the most preferred embodiment utilizes simultaneous transmission at the plurality of frequencies, this invention is not so limited. An alternative embodiment includes transmitting the signal information at each frequency separately in a rapid successive pattern. This example still only requires a single switch 28, 30 activation and provides automatic transmission at multiple frequencies. For example, three separate transmissions may occur within a one second time period.

The preferred range of the frequencies for the signal 40 extends from approximately 260 MHZ to about 470 MHZ. This range is suitable for low power radio frequency communication. When choosing the various frequencies at which the information in signal 40 is transmitted, it is preferred to select frequencies from different portions of the preferred range. In one example, three frequencies are selected. A first frequency preferably is within a lower portion of the range from about 260 MHZ to about 330 MHZ. A second frequency preferably is selected from within a central portion of the range from about 330 MHZ to about 400 MHZ. A third frequency is selected from within an upper portion of the range from about 400 MHZ to about 470 MHZ. By choosing frequencies within different portions of the range, the likelihood that a frequency will be available with limited noise is increased.

Figure 3 schematically illustrates the components of the system designed according to this invention. The remote signal transmitter 22 preferably includes a sequence control unit 60 that is responsible for determining what signal will be generated and transmitted. The sequence control unit 60 preferably includes the ability to encrypt the information within the signal that is transmitted for security purposes. The sequence control unit 60 preferably also controls whether the plurality of frequencies are used simultaneously or in a successive pattern within a selected time period. A data generator 62 generates the information within the signal that is interpreted by the system 34 to effect the desired operation. A multiple frequency generator 64 provides the plurality of frequencies at which the information from the data generator 62 will be transmitted. The information of the signal is transmitted over the plurality of frequencies by a conventional antenna 66. In the preferred embodiment, the plurality of frequencies from the multiple frequency generator 64 preferably are preselected and set or programmed into the transmitter 22 so that only a selected number of frequencies are utilized.

Given this description, those skilled in the art will be able to choose specific components to realize the function of the remote signal transmitter 22. For example, the transmitter can be implemented by using a frequency programmable oscillator, a frequency synthesizer, or an integrated saw with a varactor diode. The specific components utilized may vary depending on the needs of a particular situation.

The remote keyless entry system receiver 34 includes an antenna 70 that captures the signal transmitted by the remote transmitter 22. A selector portion 72 awaits the signal from the transmitter 22 at a selected frequency. The selected frequency is determined utilizing a detector portion 74 that monitors or detects the amount of noise at each of a plurality of frequencies. In the preferred embodiment, the detector 74 is programmed to operate so that it only monitors a preselected plurality of frequencies. These frequencies preferably are preselected to correspond directly to the frequencies that are utilized by the remote signal transmitter 22. The selector portion 72 selects the frequency at which there is the least amount of noise.

This ensures accurate and unhindered communication between the remote transmitter 22 and the receiver 34.

A multiple band receiver portion 76 is in communication with the selector 72 so that the signal captured by the antenna 70 is communicated to the receiver portion 76. The information from the received signal preferably is amplified using a conventional amplifier 78 and then communicated to a system controller 80, which is responsible for locking or unlocking the system according to the information within the transmitted signal.

Given this description, those skilled in the art will be able to choose specific components to realize the receiver 34. For example, the multiple band receiver can be implemented using a frequency adjustable superregenerating receiver or other available frequency controllable receivers. The specific components chosen may vary depending on the needs of a particular situation.

The method of operating a system designed according to this invention includes several basic steps. A plurality of distinct frequencies preferably are preselected for use in communicating the remotely generated signal to the system controller. The system controller then monitors each of the preselected frequencies to determine the amount of noise at each frequency. The frequency having the least amount of noise is selected as the receiving frequency. When the signal is transmitted at the plurality of preselected frequencies, the frequency having the least amount of noise is utilized to ensure unhindered and accurate communication. Once the signal is received it is then processed to effect the desired operation of the system.

A system and method designed according to this invention provides significant advantages compared to other systems. A system designed according to this invention is immune from narrow band noise that would otherwise compromise communication and the performance of the system. Additionally, the system performance is enhanced because there is an improvement in the range of

communication so that the transmitter may be further from the receiver than in conventional systems even when low power components are utilized. Moreover, the advantages of this invention can be realized even when using relatively low cost components, which provides significant economic advantages.

The description just given provides an example implementation of this invention by showing the currently preferred embodiment. Variations and modifications to the example embodiment may become apparent to those skilled in the art that do not necessarily depart from the purview and spirit of this invention. The scope of legal protection given to this invention can only be determined by studying the following claims.

WHAT IS CLAIMED IS:

1. A wireless system for controlling operation of a security device comprising:

a remote signal transmitter arranged to transmit a signal containing control information at a plurality of frequencies; and

a receiver comprising a detector portion arranged to detect an amount of noise at each of the plurality of frequencies, a selector portion responsive to the detector portion for selecting the frequency experiencing the least amount of noise, and a signal processor arranged to process the signal received by the receiver at the selected frequency, wherein the processor is further arranged to cause operation of the security device based on the processed signal.

2. The wireless system of claim 1 wherein the detector portion is arranged to periodically sample the amount of noise experienced at each of the plurality of frequencies.

3. The wireless system of claim 1 wherein the transmitter transmits the signal at a preselected plurality of frequencies, and wherein the detector portion only samples the noise level at the preselected frequencies.

4. The wireless system of claim 3 wherein the preselected frequencies are in a range of 260 MHZ to 470 MHZ, and wherein the preselected frequencies are spaced from each other within the range.

5. The wireless system of claim 1 wherein the transmitter is arranged to simultaneously transmit the signal at each of the plurality of frequencies.

6. The wireless system of claim 1 wherein the transmitter is arranged to transmit the signal information at the plurality of frequencies using successive transmissions at each frequency within a selected time period.

7. The wireless system of claim 1 wherein the security device comprises a vehicle remote keyless entry system, and wherein the signal control information controls locking or unlocking an entry control on the vehicle.

8. A remote keyless entry system for a vehicle, comprising:

a remote transmitter that is adapted to be carried about by a user, said transmitter being operable to transmit a selected signal at a preselected plurality of frequencies;

a detector supported by the vehicle that detects an amount of noise at each of the preselected frequencies;

a selector supported by the vehicle and in communication with said detector that selects a frequency from the plurality of frequencies with the least amount of noise at a given time; and

a receiver supported by the vehicle that receives the transmitter signal at the frequency selected by said selector.

9. The system of claim 8 further comprising a system controller that processes information from the received signal and performs a corresponding operation with the keyless entry system.

10. The system of claim 8 wherein the preselected frequencies are within a range of 260 MHZ to 470 MHZ, and wherein the preselected frequencies are spaced from each other within the range.

11. The system of claim 10 wherein the range is divided into a lower portion, a central portion, and an upper portion, and wherein at least one of the preselected frequencies are within each of the portions respectively.

12. The system of claim 8 wherein the detector portion periodically samples the amount of noise experienced at each of the plurality of frequencies, and wherein the selector updates the selected frequency according to each sample.

13. The system of claim 8 wherein the transmitter generates the signal at each frequency using independent transmissions in succession within a selected time period.

14. The system of claim 8 wherein the transmitter generates the signal at each frequency simultaneously in a single transmission.

15. A method for wirelessly controlling a security system comprising:

(a) selecting a plurality of frequencies;

(b) detecting an amount of noise at each of the selected frequencies;

(c) determining which of the frequencies has a smallest amount of noise;

(d) defining a receiving frequency as the frequency with the smallest amount of noise;

(e) transmitting a signal at each of the selected frequencies of step (a); and

(f) receiving the signal at the receiving frequency of step (d).

16. The method of claim 15 wherein step (e) includes transmitting the signal at each frequency simultaneously.

17. The method of claim 15 wherein step (a) includes selecting a first selected frequency within a lower range from about 260 MHZ to about 330 MHZ, selecting a second selected frequency within a central range from about 330 MHZ to about 400 MHZ, and selecting a third selected frequency within an upper range from about 400 MHZ to about 470 MHZ.

18. The method of claim 15 wherein steps (b), (c) and (d) are performed periodically.

19. The method of claim 15 wherein step (e) includes transmitting information that is processed by the controller to effect a desired operation of the system at each of the selected frequencies simultaneously.

20. The method of claim 15 wherein step (e) includes transmitting information that is processed by the controller to effect a desired operation of the system at each of the selected frequencies independently and in automatic succession.

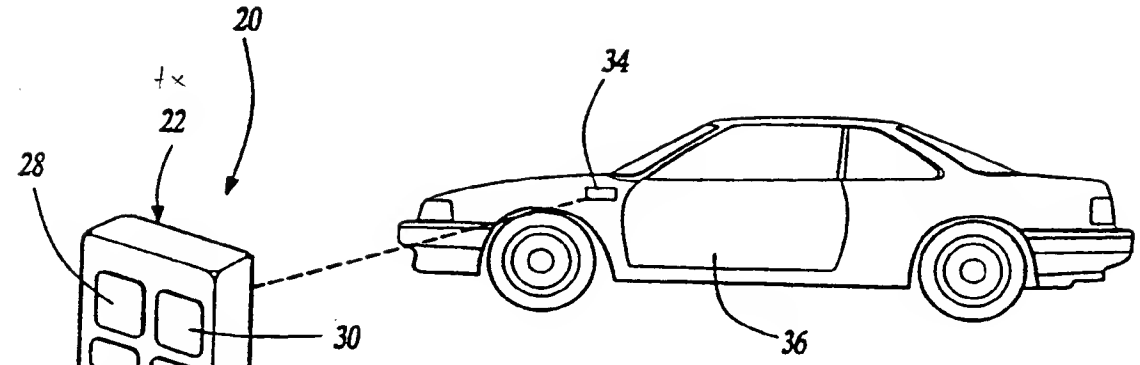


Fig-1

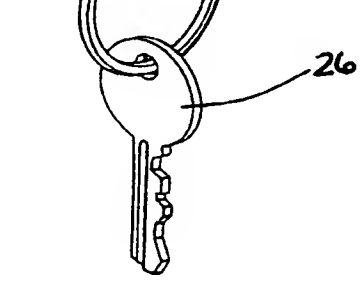
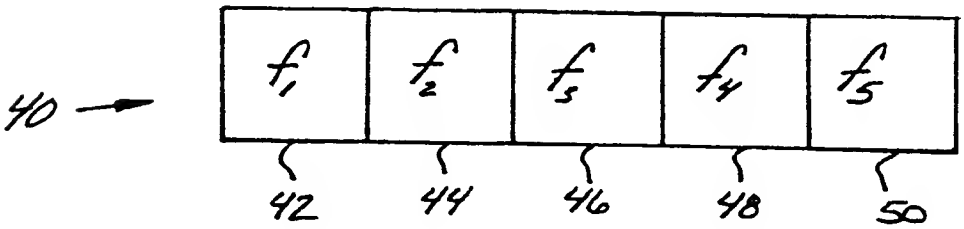


Fig-2



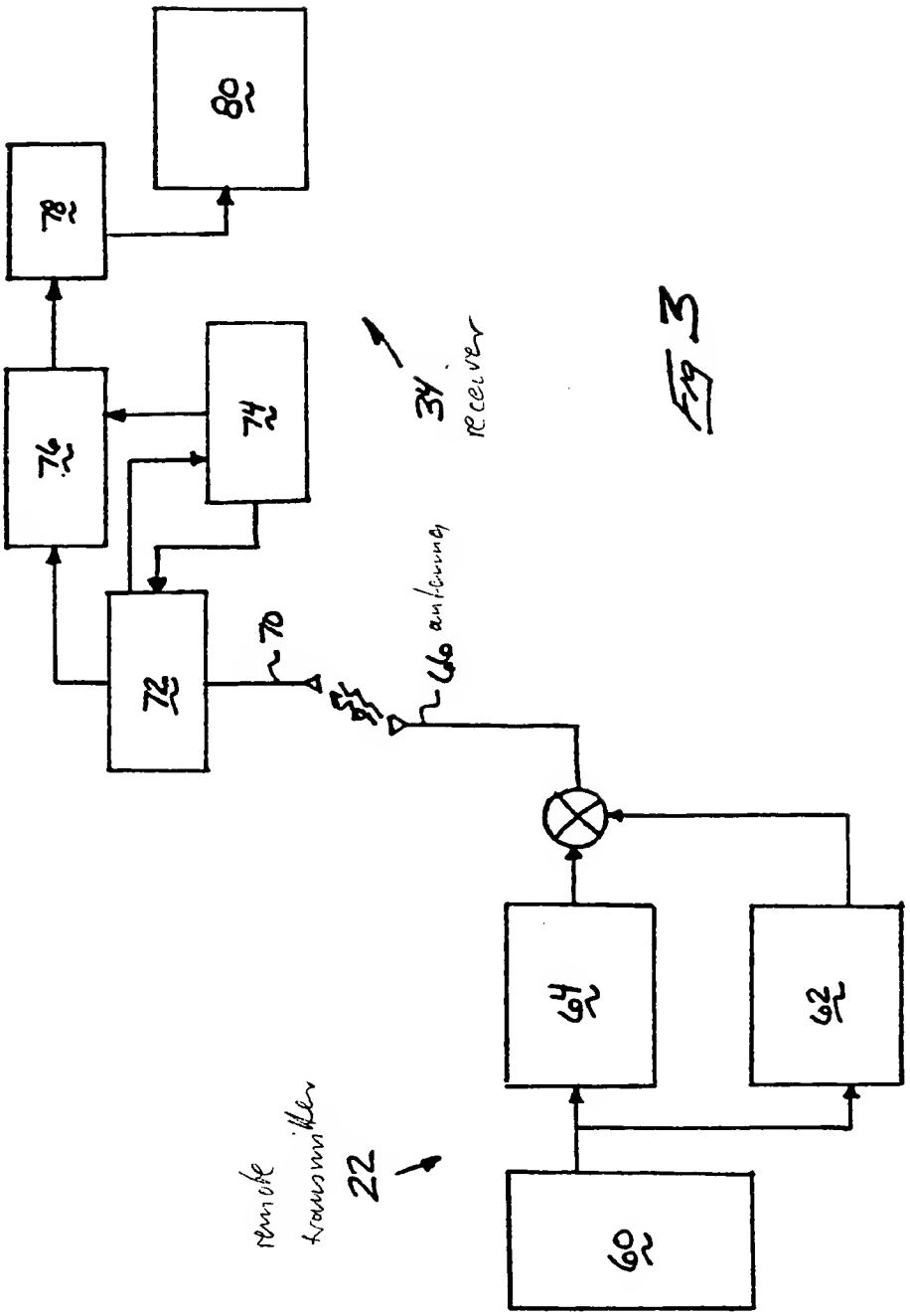

80
78
74
76
72
70
66
antenna
37
receiver
remote transmitter
22
64
62
60

Fig 3

INTERNATIONAL SEARCH REPORT

Intern ial Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E05B49/00 H04B7/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E05B H04B H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 2 311 155 A (SIEMENS AKTIENGESELLSCHAFT) 17 September 1997 (1997-09-17)	1
A	page 2, line 28 -page 8, line 25; figures 1-5	2-10, 12-16, 18-20

Y	GB 2 161 344 A (PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMLTED) 8 January 1986 (1986-01-08)	1
A	page 1, line 55 -page 2, line 40; figures 1-3	2,3,5,6, 8,9, 12-16, 18-20

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 007, no. 058 (E-163), 10 March 1983 (1983-03-10) & JP 57 204653 A (TOKYO SHIBAURA DENKI KK), 15 December 1982 (1982-12-15) abstract	1-3,5,9, 11,12, 14,16,17
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Internal Application No
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